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System Engineering Report

Meniscus Mirror Cool Down

SUBJECT PROJECT

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System Engineering Report

SUBJECT	PROJECT
MENISCUS MIRROR COOL DOWN	SOFIA

Calculations have been made to evaluate the cool down time for the meniscus mirror. The mirror is cooled from an initial temperature of 294.4 °K with nitrogen gas at 238.9 °K. Three cases have been considered:

(1). Natural convection only

(2). Blowing with 6.1 m/sec at the bottom surface

(3). Blowing with 12.2 m/sec at the bottom surface

The model is one dimensional, with 10 nodes in the direction of the thickness, which is assumed to be 6.4 cm. Convection and radiation are present at the boundary surfaces. Emissivity is 0.04 for the top surface and 0.94 for the bottom. Material for the mirror is Zerodur with the following properties: density = 2.52 g/cm^3, conductivity = 0.0164 w/cm/°K, specific heat = 0.232 w-hr/kg/°K

Fig. 1 shows the mirror average temperature vs. time for all the cases. Fig. 2 shows temperature gradients for case 2. Time constants for the mirror average temperature are 2.7 hr, 1.4 hr, and 1.1 hr for cases 1, 2, and 3 respecively.

FIG. 1

SOFIA MENISCUS MIRROR COOL DOWN (AVERAGE MIRROR TEMPERATURE)

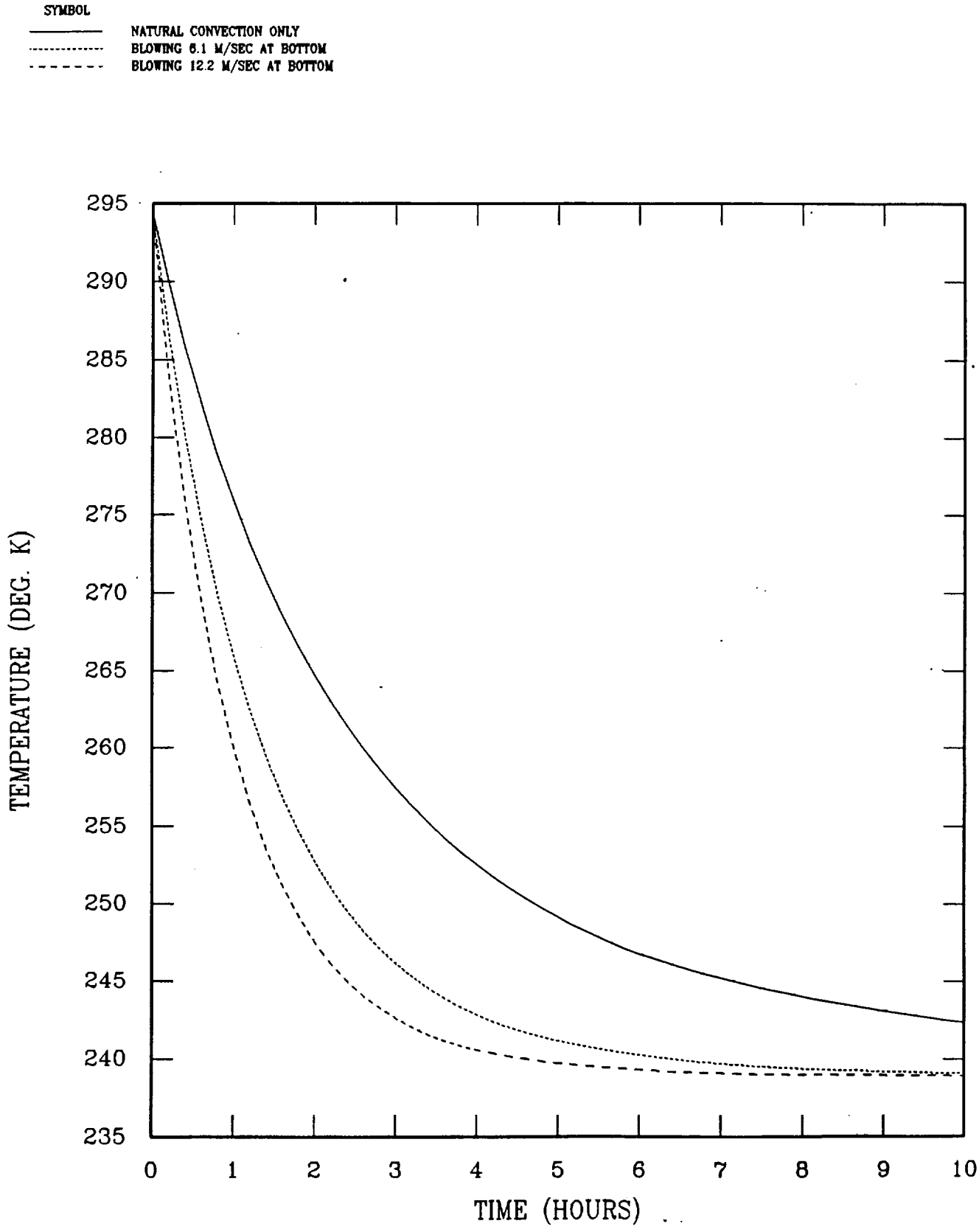

FIG. 2

SOFIA MENISCUS MIRROR COOL DOWN (TEMPERATURE GRADIENTS)
BOTTOM BLOWING, 6.1 M/SEC